Thermally Conductive Rubber ("Thubber") for Passive Cooling of Heat-Generating Hardware Embedded in Soft Goods Space Technologies, Phase I

Completed Technology Project (2018 - 2019)

Project Introduction

In this SBIR project, we will develop a passive thermal management system for microelectronics that are integrated into space suits, gloves, and other soft goods. The system will be composed of a thermally conductive rubber that is molded around the heat-producing components. In order to enable mechanical deformation, the microelectronic components will be wired together with soft and stretchable circuitry. In general, the circuit wiring can be any soft conductor that maintains low electrical resistivity when stretched. For the purposes of this project, we will use wiring composed of a non-toxic, biocompatible eutectic alloy of gallium and indium.

Anticipated Benefits

Potential applications include space suits, assistive robotic systems (X1 Robotic Exoskeleton, Space Suit Robotic) Glove, and human-machine interfaces used for humanoid robots (Robonaut 2). These technologies contain embedded motors, sensors, microelectronic processors, batteries, and other heat generating components. As the number of these components increases, the soft goods architectures used in these application must be engineered to efficiently manage heat and avoid thermal hotspots.

The technologies developed in this proposal will also be applicable to wearable electronics for biomonitoring, augmented/virtual reality, and personal computing. These applications require integrated heat management systems that have a small form factor and do not rely on bulky hardware for heat exchange. However, because the system is integrated into a deformable soft goods architecture, it must also be flexible, stretchable, and mechanically robust.

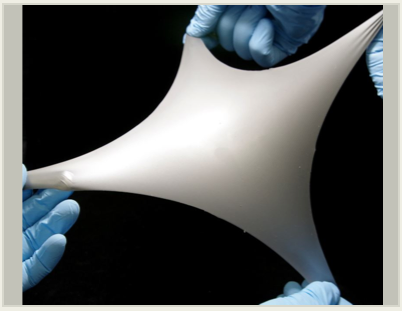

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Table of Contents

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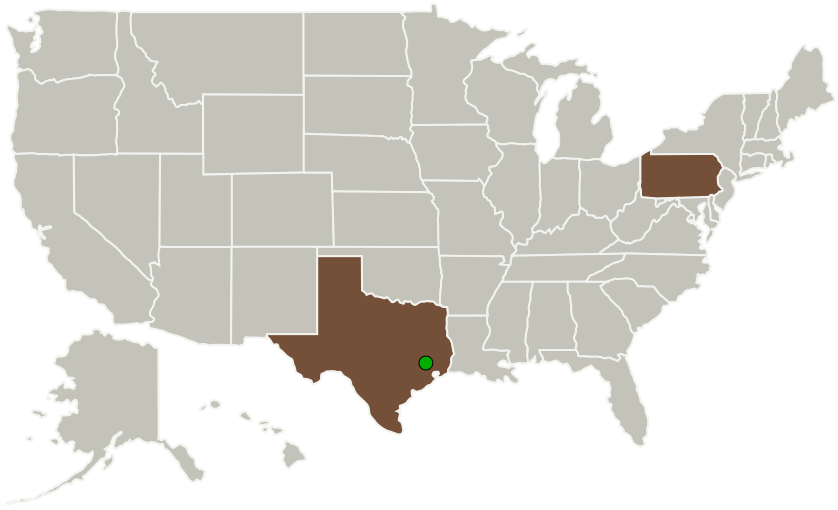
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
ARIECA, LLC	Lead Organization	Industry	Pittsburgh, Pennsylvania
Johnson Space Center(JSC)	Supporting Organization	NASA Center	Houston, Texas

Primary U.S. Work Locations	
Pennsylvania	Texas

Project Transitions

July 2018: Project Start

February 2019: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/139744)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

ARIECA, LLC

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

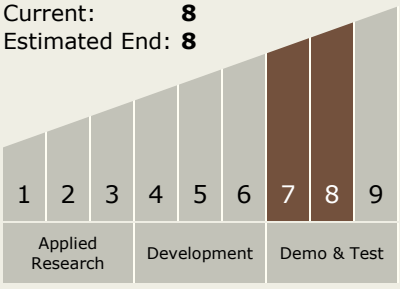
Carlos Torrez

Principal Investigator:

Cantwell Carson

Technology Maturity (TRL)

Start: **7**
Current: **8**
Estimated End: **8**



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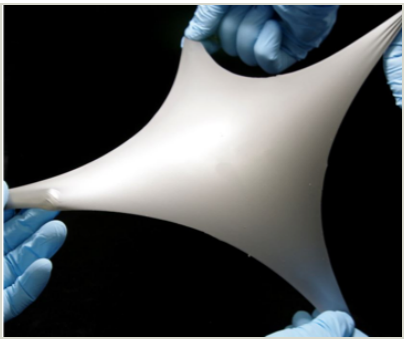
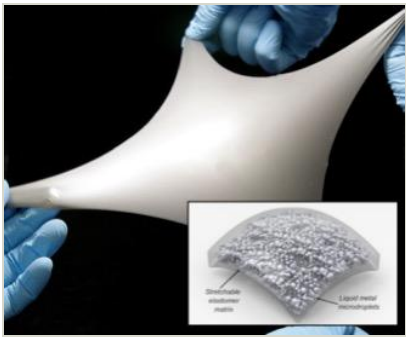
Images



Briefing Chart Image
Thermally Conductive Rubber ("Thubber") for Passive Cooling of Heat-Generating Hardware Embedded in Soft Goods Space Technologies, Phase I
(https://techport.nasa.gov/image/130875)



Final Summary Chart Image
Thermally Conductive Rubber ("Thubber") for Passive Cooling of Heat-Generating Hardware Embedded in Soft Goods Space Technologies, Phase I
(https://techport.nasa.gov/image/132800)

Technology Areas

Primary:

- TX14 Thermal Management Systems
  - TX14.2 Thermal Control Components and Systems
    - TX14.2.2 Heat Transport

Target Destinations

Earth, The Moon, Mars